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THE AIR CUSHION TRANSPORTER - SOLUTION TO MANY ARCTIC PROBLEMS

by L. G. Nichols

Arctic Engineers and Constructors

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THE AIR CUSHION TRANSPORTER
SOLUTION TO MANY ARCTIC TRANSPORTATION PROBLEMS

by

Lloyd G. Nichols

August 31, 1971

presented to

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Air Cushion Technology

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During the past five years increasing emphasis has been placed on the importance of the abundant natural resources which exist in the Arctic. Exploration and development activities have accelerated at a rapid pace. However, because of the delicate terrain and severe environmental conditions which exist in the Arctic, operators have encountered extreme difficulties and have incurred large expenditures in transporting heavy equipment. Recognizing this problem, we set as our primary objective the development of a method of economical transportation for movement of drilling and construction equipment in the Arctic.

Arctic Engineers and Constructors, a joint venture of Global Marine Inc. and Raymond International Inc., was formed to create a single company with the capability and experience to offer a complete construction and drilling service to petroleum industry clients in the Alaskan and Canadian Arctic.

Prior to the formation of Arctic Engineers and Constructors, engineers of our parent companies conducted extensive environmental, design, equipment and engineering studies of the problems involved in the search for and production of petroleum in the Arctic. As a result of these studies, we concluded that large, non-self-propelled air cushion vehicles would help solve the heavy equipment transportation problem and would significantly reduce the costs to the operators. Because no such vehicles were available, we initiated a development program.

The first step of this program was the design of a 100-ton payload Air Cushion Transporter (hereafter called the "ACT-100"). It was designed to have the capability to transport and serve as foundation support for drilling and construction equipment. It was designed to operate over land, water, ice, snow, and soft ground without danger of unduly damaging the terrain or becoming bogged down. It is not self-propelled, thereby eliminating the most expensive and sophisticated portions of conventional self-propelled air cushion vehicles -- the propulsion and control systems. The ACT-100 does not require highly trained and licensed personnel for its operation and maintenance.

Because proper skirt design is of great importance, we went directly to England to obtain licensing and skirt design assistance. We are licensed by Hovercraft Development Limited and we assigned responsibility for skirt design and manufacture to Air Cushion Equipment Ltd. of Southampton, England, who are the foremost authority on applications of segmented skirt systems.

Development and testing of the prototype ACT-100 was funded jointly by the Canadian Government under their Program for the Advancement of Industrial Technology (PAIT), Sun Oil Company, Arctic Engineers and Constructors and our Canadian affiliate, Arctic Systems Ltd.

The contract for construction of the ACT-100 hull was awarded to Dominion Bridge Company Ltd. of Edmonton, Alberta. Fabrication of the hull began January 18, 1971. The hull was fabricated in three longitudinal sections so that it could easily be transported to the field assembly area for joining and for final machinery, piping, and wiring installations. The three hull sections were trucked to the field assembly site on March 9, a little less than two months after fabrication had begun.

Fitting of the skirts began during the latter part of March and the installation of equipment was carried out through most of April. The ACT-100 lifted off for the first time on April 26 to begin the first phase of testing.

The first phase of testing was completed on June 24. During this two-month period our major objectives were to evaluate overall performance of the ACT-100 and to evaluate towing vehicles. Public demonstrations of the ACT-100 were held during the week of June 7 for representatives of the petroleum industry, the construction industry, the pipeline industry, Canadian and U.S. Governments, and members of the press. The response of those attending these demonstrations was very gratifying. At the conclusion of this paper a film will be shown of the ACT-100 in action.

We are pleased by the results of the first series of tests on the ACT-100. Its overall performance was excellent. It proved to be very stiff and stable, and it has very good terrain-negotiating ability. The ACT-100 can easily clear obstacles up to four feet high, and repeatedly demonstrated its ability to traverse ditches and vertical steps of greater depth. Towing speed is entirely dependent on the tow vehicle used, and proved to be about eight mph on level terrain. Towbar pull required on level terrain is 10,000 pounds for the fully loaded ACT which has a gross weight of 250 tons. Performance over water and swamps was excellent. The effects of the ACT on the terrain were minimal and were well within acceptable limits.

The ACT is being prepared for shipment to Great Slave Lake where it will undergo a second phase of testing this winter on both lake ice and shoreline conditions.

Sun Oil Company sees the air cushion system as a way of drilling offshore wells while surrounded by Arctic ice, a procedure not previously attempted. After further testing of the ACT-100 Sun expects to support development of subsequent phases of the system. These include construction of a much larger unit that incorporates a complete self-contained drilling system, with ice-melting capability that will allow the unit to achieve and hold position while drilling, despite gradual movement of the ice layer.

The ACT-100 is simply an all-steel, box-type hull which has a flexible air containment skirt around its perimeter and a large-volume air supply system mounted on its deck. Air is forced under the hull, causing the skirt to form a partial seal with the ground. Principal features of the ACT-100 design are:

1. All equipment and machinery were designed for operational temperatures of minus 60 to plus 70 degrees Fahrenheit.

2. The ACT was designed to have sufficient stiffness, stability, and control to permit operations in winds up to 25 mph.
3. It can travel over obstacles and ridges as high as four feet and can negotiate changes in terrain elevation such as the transition from a flat surface to a slope of 1:10.
4. The air cushion skirt was designed to be entirely peripheral so that no portion of the skirt will be underneath the hull when the cushion is deflated. This helps to prevent damage and gives easy access to the skirt for maintenance.
5. The only significant contact with the terrain is that of the bottom-mounted, rubber-tired wheels which provide directional control and maneuverability assistance. They are constant load wheels which can be adjusted to the existing terrain conditions. Wheel pressure on the terrain can be adjusted from zero load (fully retracted) to ten percent of the payload.
6. A refrigeration system has been designed for the hull so that permafrost can be maintained in its frozen state beneath the unit during the winter and summer to serve as its foundation support. This feature eliminates the necessity of expensive pile and gravel drilling pads. The refrigeration system can be converted to a heating system which will facilitate separation of the hull from the frozen ground prior to a rig move.
7. Operation and maintenance of the ACT can be performed by oilfield or construction maintenance personnel.

There are three basic conditions that lend extreme viability to the use of Air Cushion Transporters. They are:

1. A need to transport heavy loads.
2. Relatively level terrain.
3. Terrain which has low load bearing characteristics.

If all three of these conditions exist, then the ACT can be very competitive, operationally and economically, with any other method of transport. If only one or two of these conditions exist, there are still some areas where the ACT will be economically competitive with more conventional forms of transport.

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